

CLAIMS

- 1) A method (and computer process) for producing optimal purchase schedules, the method comprising the steps of,
 - a) Creating the supply channels models, said model defining attributes of the supply channel including supply channel master data of items, requisitioning sites, vendors, vendor sites, transport modes; supply agreement parameters; and corporate business rules
 - b) Creating the scope for planning, define optimization configurations, formulating linear programming and mixed integer linear programming models based on the created supply channel models, and run the optimizer
 - c) Analyzing the output purchase schedules, that may consist of real and virtual planning scenarios, through analysis of the purchases costs; basic prices; contractual obligations, rebates and penalties; fulfillment; and schedule compliance to contractual terms
 - d) Further analyzing the enterprise's own compliance on purchase quantities and flex limits; payment terms; and lead time provided for order processing, supply and transportation; costs and taxes; and basic prices; before the purchase schedules are finalized as orders and sent to the vendor
- 2) The method of claim 1 wherein the step of creating a supply channel model further comprises of the following steps,
 - a) Creating a supply agreement by identifying a vendor, items covered for supply in this agreement, identify vendor ship locations, identify receiving locations, and other parameters of effective dates, payment terms, compliance requirements for lead-times for order processing, manufacture and transportation; maintaining versions and activating
 - b) Modeling the basic price that may be modeled as fixed unit price, volume based discounting structure, fixed unit price varying by time, formula based pricing

using one or more parameter that changes with time, formula based pricing using one or more parameter that changes with time and where the computing formula itself may change with time

- c) Model costs other than the basic price, where such costs may be modeled as an absolute value, as a percentage of another cost definition, as a percentage of basic price, as a function of the quantity, as a function of the transportation route specifying a shipment origin and destination pair, costs that are a combination of absolute values and percentage of another cost or basic price
- d) Associate the costs thus modeled either at the agreement level, or at a line item level where these line items are individual items that are identified for supply in the agreement
- e) Define specific planning time buckets referenced as frozen and collaboration periods each allowing the user to specify collaboration parameters with the vendor with whom the agreement is being modeled, these parameters being the up and down flex percentages on the projected quantity demands during the future time periods, and the duration of the frozen and collaborative time buckets; and may be specified for the whole agreement, at the line-item level, or the requisitioning site and item level
- f) Select system events based on purchase transaction life cycle milestones that are defined and provided by the system, and/or define user events by specifying the direction and duration in days from the selected system event
- g) Define payment terms by using the above events, either modeling an absolute amount to be paid associated with an event, or a percentage of expected value of the purchase schedule; or by associating a pre-defined payment term from another agreement that may either be a parent agreement or an independent agreement with same or another vendor
- h) Create capacity calendars for vendor sites when no supplies can be made and associate these calendars with the specific vendors

- i) Create receiving location calendars when no receipts can be made and associate these calendars with the specified receiving location
- j) Specify agreement terms on quantities for lot sizes, minimum order quantity, and maximum order quantity for the orders placed under the agreement reference
- k) Model supply network by providing receiving locations, supplying locations and transportation modes, and specifying the valid combinations of the three for the specified agreement
- l) Specify ordering related parameters of order handling or processing time, maximum number of orders that would be processed free by the vendor under the agreement, order handling fee after the maximum number of free orders has been reached under the said agreement
- m) Model and specify lead times related to transportation lead time between the supplying and receiving locations; order processing lead time for a specific agreement; manufacturing or supply lead time; and expedited lead times for each of the above situations when expedite fee is specified and paid
- n) Model supplier capacities for different items, or for supply-site and item combinations
- o) Specify obligations and penalties when these obligations are not met; obligations being specified in quantities at line-item level, or currency values at agreement, or individual line-item levels; penalties in absolute value, and/or percentage of shortness on obligation; both obligations and penalties being thus modeled either to be constant through time or varying with time
- p) Specify available rebates under the agreement when a particular business volume has been achieved; such rebate point being defined either by value at the agreement or a line-item level; or by value or quantity at the line-item level; and rebate itself being either in absolute currency value and/or percentage of currency value of business volume above rebate point; and such rebates being fixed over time, or variable through time

- q) Specify corporate policy for achieving a recommended business split among multiple potential vendors for supplying the same item
 - r) Model corporate home currency; and other currencies that the enterprise might use; and model exchange rates among multiple currencies modeled; and specify the default currency for financial dealings on the specified agreement
 - s) Marking the status of the agreement as active to indicate to the system that the agreement can be included in optimization runs as a potential supply channel
- 3) The method of claim 1 wherein the step of creating the scope for planning, defining optimization configurations and running the optimizer further comprises of the following steps,
- a) Creating planning groups by grouping items together manually; and the system further expanding the scope of the items in the group for a given optimization run automatically
 - b) Create a planning calendar specifying the plan start and end dates, and dividing the intervening time into buckets of time each individually identified, and of individual duration that may be in days, weeks, months, quarters or years
 - c) Associating a default planning calendar for each item group created
 - d) Modeling a earliest release date specifying to the optimizer the first date when the purchase schedule can be generated
 - e) Specifying the scope of the problem either through a template or independent of it, such a scope consisting of the requisitioning sites and requisitioned items combinations
 - f) Defining the optimization configurations by specifying the following parameters of the optimizer solver; number of supply expedite lead-time buckets, being the number of buckets through which the material can be ordered in advance; lot-size multiple constraint horizon, being the point in horizon through which the lot-sizing rules must be applied on the generated system output; minimum lot size constraint horizon, being the point in horizon through which the minimum order lot-size rules must be applied on the generated system output; flag for allowing

- shortness either by lot size multiple or minimum lot size; flag for ignoring prices and costs
- g) Specifying the optimization execution parameters either by providing parameters for automatically scheduling the process or manually executing the optimization process
- 4) The method of claim 3 to automatically expand the scope of the planning item groups to include other items that are related through supply contracts conditions of common obligations, penalties, and rebate values where such commonality affects the procurement costs, and therefore optimal purchasing solution
- 5) The method of claim 1 to formulate linear programming and mixed integer linear programming problems, where in the parametric values required for problem formulations are computed, these being as follows: automatic computation of consolidated need quantities for each time bucket in the planning horizon; automatic computation of consolidated supplier capacity for each time bucket in the planning horizon; automatically computing the pro-rated obligations and rebates effective for the planning horizon when such horizon ends before the effective end date of the contracts; automatic computation of the effective landed price in each planning bucket when prices vary by time; and automatically considering any excess quantities planned to be purchased in previous buckets and compensating for such excess quantities
- 6) The method of claim 1 for computing the compliance scores for each individual purchase schedule by measuring such compliance against the agreement parameters of the basic price; other costs covered and modeled in the agreement; transportation routes; lot-size multiple; order lot size; payment and credit terms; lead time for order processing and order acknowledgements; order fulfillment on time and quantity ordered; lead time for supply; lead time for transportation; expedite lead time requests; and expedite process fees when such fees is due
- 7) The method of claim 1 for creating, maintaining and comparing the scenarios in which virtual agreements have been modeled for the purpose of evaluating the effects

of such agreements on existing supply situations, projected purchase costs and agreement terms

- 8) A method for computing effective landed cost where one component of such landed cost computation is basic price that varies with time, or is modeled using a formula that itself can change with time, as well as use an external variable that may be dependent on time for its value
- 9) The method of claim 8, for computing effective landed cost where components of such landed cost computation are costs that are a function of one or more of the basic price; time; quantity; transportation route defined as a pair of shipping location and requisitioning location; and can be a combination of absolute value and / or percentage of another cost
- 10) A method for defining custom user-specified events where such custom events can be defined using the system events that are based on the purchase transaction life cycle; and are further used for modeling payment terms that may consist of absolute amounts or percentage of the order value
- 11) The method of claim 5, for computing the pro-rated rebates, obligations and penalties when such obligations and penalties vary with time during the plan horizon; and/or when the contract effective end-dates are beyond the modeled planning horizon
- 12) The method of claim 1, for formulating linear programming and mixed integer linear programming models, where in the costs based on quantity basis greater than 1 are solved in two iterations; the costs being converted to a quantity basis of 1 in the first iteration model, and being modeled with the actual quantity basis along with tighter bounds for integer variables, in the second iteration.
- 13) The method of claim 1, for formulating linear programming and mixed integer linear programming models, where in the models with lot sizing restrictions are solved in two iterations; the lot sizing restrictions being ignored in the first iteration and the same being considered in the second iteration using a reformulated model based on the solution from the first iteration.

- 14) A system for optimizing supply channels, such a system comprising of an input device for modeling the supply channels; a storage device for storing the supply channels; a problem formulator to formulate the problem for optimization; an optimizer to solve the problem; and an output device to review and analyze the results of the optimized purchase schedules
- 15) The system of claim 14 further comprising a display device for displaying the supply channel modeling with agreements and their attributes, and for displaying the optimized purchase schedules
- 16) The system of claim 14 wherein the supply channel model describes the purchase agreements, items, vendors, shipping locations for these vendors, requisitioning locations, pairs of valid combinations of these locations with valid transportation modes for the purchase process
- 17) The system of claim 14 wherein the optimizer is a linear programmer or a mixed integer linear programmer
- 18) A program storage device readable by a machine, with a program of instructions, executable by a machine to perform the method steps of defining model for supply channels and supply contracts; optimizing for producing the minimum cost purchase schedule, given a supply channel data model and projected material requirements; defining optimization configurations; defining scenarios; optimizing such scenarios; and computing consolidated results for analyzing the purchase schedule output for costs, contract utilization and contract comparison